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DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL PROTECTION

333 W. Nye Lane, Room 138
Carson City, Nevada 89706

August 7, 2003

Mr. Dave McCarthy
Atlantic Richfield Company
307 E Park Ave.
Anaconda, Montana 59711

SUBJECT: **Draft Yerington Pit Lake Work Plan**

Dear Mr. McCarthy:

The Nevada Division of Environmental Protection (NDEP), BLM and EPA (Agencies) received, reviewed and evaluated the, **Draft Yerington Pit Lake Work Plan** dated January 30, 2003, regarding the continued environmental investigation of the Yerington Mine, located in Lyon County near Yerington Nevada.

The NDEP and the Agencies comments on all draft and draft final work plans have been submitted to Atlantic Richfield Company (ARC) with the intent of providing guidance and direction in crafting work plans in accordance with CERCLA, the National Contingency Plan (NCP), State of Nevada statutes and regulations, and standard scientific and engineering principles and practices associated with implementing remedial investigations.

On July 7, 2003, the NDEP and Agencies and ARC representatives met at the NDEP offices to discuss inadequacies of the **Draft Final Process Areas Work Plan**. The purpose of this meeting was to assist ARC in producing an acceptable **Final Process Areas Work Plan** and to establish a template for all future final work plans. It is the NDEP and Agencies hope that the meeting assisted you by providing the necessary guidance to allow you to successfully complete all forthcoming final work plans. The NDEP may pursue enforcement actions if any of these Final Work Plans are determined to be unacceptable to the regulatory agencies. Enforcement may include stipulated penalties as provided for in the Administrative Order on Consent between ARC and NDEP. ARC also may be liable for costs incurred by NDEP, EPA, and BLM if ARC fails to adequately respond to the site conditions.

The NDEP and the Agencies have the following comments and concerns:

General Comments

In general, the work plan appears to have been developed around a preconceived outcome (hypothesis) that the Yerington Pit Lake is a terminal system with non-degrading or improving water quality conditions. While this hypothesis is a possibility, it is only one of several possible outcomes. The work plan should be designed to evaluate the potential for all plausible scenarios, otherwise unresolved issues will remain. Findings of the proposed investigations will then support the most likely scenario(s) and discount the others.

Several hypothesis and assumptions are made in the work plan, however, tests (remedial investigations) to validate these are not proposed, or are insufficient. For example, an assumption is made that "steady-state" hydraulic conditions will control "steady-state" water quality characteristics. This assumption needs to be explored in greater detail because it may or may not be valid. What are the processes at work here? The draft work plan tends to focus on the physiochemical factors influencing pit lake water quality. For example, the pit lake conceptual model schematic (see Figure 10) illustrates the various hydrologic exchange mechanisms to be considered in the water balance, but what about the geochemical and biogeochemical reactions associated with each of the compartments in this conceptual model? Chemical (pH, redox, saturation indices, etc.) and biological (biologically mediated reactions) factors also will play an important role in the equilibrium water chemistry of the pit lake. How are hydraulic processes linked to chemical and biological processes? Is this "steady-state" assumption made purely on empirical evidence collected over the past several years? It is important for the work plan to address how all factors (physical, chemical, and biological) related to the pit lake water balance and water quality will be evaluated.

Also, this work plan does not attempt to identify potential source areas that may be impacting groundwater. Without identifying these potential source areas, it will be next to impossible to determine appropriate remedial actions (closure alternative). Other work plans that are cited in this plan lack the necessary remedial investigations to adequately identify potential source areas. This plan, as well as the others, must be significantly improved upon in order to be approved

Although a considerable amount of data has already been collected on water quality in the Yerington Mine pit lake, it will likely change as the pit continues to fill. The accuracy of pit lake models in predicting concentrations of contaminants in pit lakes is currently unknown (National Academy of Sciences 1999). Predicted concentrations may not match actual concentrations. Therefore, water quality of pit lakes should continue to be monitored throughout filling to evaluate how the water chemistry changes with time (National Academy of Sciences 1999).

Adequate information does not exist on the potential development of biological communities in pit lakes and their impacts on aquatic biota and wildlife (National Academy of Sciences 1999). For example, shallow aquatic communities may develop on ramps following filling of the pit lake. Such areas may become attractive to small numbers of aquatic migratory birds. The uptake of various metals and trace elements, especially those that are readily bioaccumulated or biomagnified through the food chain (e.g., mercury and selenium), needs to be carefully considered in an ecological risk assessment for the pit lake. We are concerned about the lack of plans to collect data on metals and trace elements in aquatic biota in the Yerington Mine pit lake. Such data is critically needed to determine current and future ecological risks.

Our concerns are ultimately related to current and likely future use of the pit lake by a variety of migratory birds and other wildlife. Migratory birds already appear to be consuming foods from the limited aquatic community that currently exists in the pit lake. Risks to such species need to be carefully evaluated.

Specific Comments

The following specific comments are intended to direct attention to the major deficiencies within the proposed work plan and need to be addressed with meaningful and significant revisions.

1) Page 1, first bullet: "*Evaluate the hydraulic relationship (i.e., water levels and gradient) between the bedrock groundwater flow system that surrounds the Yerington Pit and water in the pit:"*

Hydraulic relationships should be investigated for all inflow components contributing to the Pit Lake. Because the alluvial aquifer has been documented to discharge into the pit lake (see page 8, third paragraph) its relationship to the lake should also be quantified. In addition, surface water components such as the Walker River, should also be investigated and quantified. The work plan must be modified to address all hydraulic and geochemical components to the water balance issues of the pit lake.

In order to adequately address this relationship ARC must 1) evaluate existing monitor wells to determine their adequacy and report the findings in this work plan, and 2) propose new monitor wells that will adequately evaluate groundwater conditions around the pit lake.

2) Page 1, second bullet: Providing adequate groundwater coverage around the perimeter of the pit lake will also help determine flow direction and characteristics between the pit and groundwater (see comment above).

3) Page 1, third bullet: *"Confirm the hydrochemical stability of the lake to provide the basis to assess potential impacts to groundwater, if the pit has the potential to become a flow-through system, and potential human health and ecological risk."*

The objectives listed in bullets #2 and #3, are based upon "predictions" or forward modeling. In order for risk to be assessed, or modeled, hydrochemical sampling must focus on all relevant hydrochemical components, which should include the water chemistry of the pit, as well as for surface water, bedrock groundwater and alluvial groundwater. The proposed work plan will not adequately determine the chemical stability of the pit lake water nor will it adequately determine whether the pit lake will become a flow through system (see comment above). More sampling in the lake away from the shore and at depth must be proposed.

4) Page 2, Section 1.2: The text does not explain or discuss the current continual loss of water from the Walker River to the Pit Lake.

5) Page 2, last paragraph, second Sentence: *"Some of the remaining perimeter wells are shown in Figure 3, along with other monitor wells."*

What is the justification for only presenting some of the perimeter wells? Further, the completion records, drill logs, and other relevant information regarding the adequacies of the proposed wells to fulfill the given objectives are not provided anywhere in this plan. In order for these listed wells to be utilized they must have data of adequate quality and accuracy. See DQOs presented in this plan. All perimeter and monitoring wells should be shown in Figure 3.

If adequate well records are not available, video logging of the existing wells could be proposed to determine depth, interval and size of screen along with well completion depth. However, the hydrogeologic characteristics of monitor wells can't be determined by the use of this technique alone and will have to be determined through the implementation of other techniques.

6) Page 3, 1.2 Past Mining Operations and Current Conditions: Seegmiller (1978) is cited on the third line of the page. The References Cited do not list a report by this author for this year.

7) **Page 3**, **third paragraph regarding Figure 4:** What is meant by the statement *"The shape of the recovery curve is commonly seen in pit lakes developed in hard rock mining environments (e.g., Moreno and Sinton, 2002)."*?

8) **Page 4, 1.3 Physical Setting, Climatic Setting:** Dingman (1994) is cited in the last line of the page; however, it is not listed with the References Cited.

9) **Pages 5-7, 1.3 Physical Setting, Geologic Setting :** A citation, presumably Wilson (1963), should be provided on page 5 for the information provided in the second paragraph. In the second line of the second paragraph on page 6, Figure 5 should be cited, not Figure 4. Geologic cross-sections A-A' and C-C' in Figures 5 and 6 are mentioned in the last paragraph on page 6. It would be helpful to show the approximate locations of these cross-sections through the pit area on a map. Figure 7 is cited on page 7; the direction for North should be provided on this figure for clarity.

10) **Page 7, Pit Hydrology:** *"A relatively small number of these wells that remain are shown in Figure 3."*

See comment 5. What happened to the other wells and how many were there? Because of their unknown construction, an attempt to locate these older wells may be necessary to prohibit leakage of contaminated groundwater to lower aquifers. Figure 3 presents the relative location of wells around the perimeter of the pit, some are labeled "inaccessible", and reasons aren't discussed. As previously stated, the adequacy of these wells needs to be investigated and approved for use in this work plan.

The color scheme and well symbols used in Figure 3 are confusing because they are too similar. An attempt should be made to make this easier to read. State the number of wells that remain instead of referring the reader to Figure 3.

11) **Page 8, first paragraph:** If it is indeed a matter of back-calculating the bedrock contribution to pit refilling, then why not do the calculation and present the findings in this work plan? For example, why is only one year of data collection proposed? What will one year of data collection accomplish? The work plan proposes that one additional year of data collection will *"refine the anticipated time frame that will be required for the pit lake to reach "steady state" hydraulic conditions, which will be useful in the evaluation of closure options for this mine unit."* On the contrary, the proposed work plan will do little to lessen the uncertainty that would've existed (will exist) if the work plan had presented the bedrock contribution to pit refilling based on the data at hand.

12) **Page 8, Figure 8:** The "snapshot" of the potentiometric surface around the pit lake appears to be based on the elevation of the pit lake and the water level in one monitoring well. More data will be needed to accurately determine ground-water flow patterns in the vicinity of the pit and to estimate subsurface discharges to the pit.

13) **Page 8, last sentence of the third paragraph**: Does the seepage at the east margin of the pit come from the Walker River through alluvium or would it be more accurate to state that the seepage is from ground water from Mason Valley? Is the Walker River a losing or a gaining reach in this area? We have the same concerns with similar wording on pages 15 and 18.

14) **Page 9, first paragraph (continued from page 8):** *"The groundwater elevation, measured in WW-59 … can be compared to the most recent pit lake elevation…"*

Why is a comparison of pit lake elevation being made to groundwater elevation that is about nine months apart? Isotropic conditions are assumed, but also assumed is that WW-59 is an appropriate well to use in this characterization effort. A groundwater elevation from a single well cannot be compared to the pit lake

elevation without a great deal of unacceptable uncertainty given the hydrogeologic setting and the uncertainty with this well (see ground water comments in "conditions" plan).

The date of this lake measurement should be provided here in this paragraph and in Figure 8. The completion record of WW-59 is not provided in this report, and therefore, it is unknown if its use is appropriate for the Pit Lake investigation. Drill logs and completion records for all the wells used in this investigation need to be provided in the work plan

15) Page 9, Water Quality Data, first bullet: If well logs are not or cannot be provided, then their adequacy will always remain in question, the result will be that those wells will have to be replaced. If adequate well records are not available, video logging of the existing wells could be proposed to determine depth, interval and size of the screen along with the well completion depth. However, the hydrogeologic characteristics of monitor wells can't be determined by the use of this technique alone and will have to be determined through the implementation of other techniques.

16) Pages 9-10, 1.3 Physical Setting, Water Quality Data: In the third bullet following the first sentence, a number of water samples have been collected at 110 meters below the surface, not 100 meters. At the end of the second paragraph it would be helpful to provide information on some major exceptions to the similarities between water quality in groundwater wells and that found in the pit lake. Information could be provided for aluminum, calcium, magnesium, sulfate, and selenium.

The extreme variability in selenium concentrations depicted in the second figure of Appendix A is likely due to the locations where the samples were collected. Stanley Wiemeyer talked to Joe Sawyer on May 22, 2002, at a Yerington Technical Work Group meeting about sampling locations. Mr. Sawyer indicated that he had collected some of the yearly pit lake water samples for analysis when Arimetco was in operation at the site and that he collected samples from the edge of the lake near where water inflow was present. This may account for the absence of elevated selenium concentrations in such samples from that period. Therefore, this data should be used with great caution or even be discarded, as the data would not be truly representative of overall water quality in the pit lake.

17) Page 9. Water Quality Data, second paragraph: The unit of measurement needs to be provided in Table 3.

18) Page 9, second paragraph: Why are the wells inaccessible? Indicate which wells are inaccessible on Table 3. Last sentence, *"The concentrations of constituents from the perimeter groundwater wells are generally similar to concentrations found in the pit late (Table5)."* Well logs are not provided for W2B and WW-36, and WW-59 is not constructed properly (see "conditions" comments); therefore, unacceptable uncertainty remains when comparing hydro-chemistries. More monitor wells must be proposed using Fig. 7 as a guide.

19) Page 10, paragraph continued from page 9: What are ARCs conclusions regarding the time concentration plots in Appendix A?

20) Page 11, Limnologic Data, second paragraph: We disagree with the conclusion provided in the second sentence of the second full paragraph on this page. Furthermore, it does not appear to be supported by Jewell (2002) who stated "The addition of sulfate is no doubt the result of sulfide weathering and could increase in the future. Behavior of other major elements is difficult to model..." and, "The lake contains elevated concentrations of selenium which will increase over time..."

Information on residues of elements in samples of biota that were collected as part of the study conducted by PTI (1996) should be included in this draft work plan because they would be helpful in estimating ecological risk in the future. The report provides information on

concentrations of antimony, arsenic, cadmium, copper, lead, mercury, methyl mercury, selenium, silver, and zinc in plant tissue (separate samples of *Typha* sp. and *Ludwigia* sp.) and macroinvertebrate tissue (insect composite) from the pit lake. Regarding the chemical characteristics of the pit lake, Jewel's conclusion is that copper, sulfate, and iron will remain high and the prediction is that the lake will be a flow-through system. So copper, sulfate, and iron will impact groundwater. There needs to be a link with the pit lake and groundwater. This is a major problem with the reports.

As Jewel stated in the report, *"The exact nature of these impacts depends on factors (primarily the hydraulic conductivity and the regional hydraulic gradients) which are beyond the scope of this report."* The proposed work plan does not attempt to collect this type of important information; therefore, without this information the proposed work plan will remain deficient.

Jewel also concludes that the pit lake will be a flow-through system, so copper, sulfide, and iron will (may) impact groundwater.

21) Page 11, Section 1.4, Step One: It appears that the answer to the problem statement (step one), *"Future hydrochemical conditions of the Yerington Pit Lake are not completely known, and available information must be evaluated with respect to the fate and transport of potential CoCs in the pit lake that may pose a human health or ecological risk,"* has already been predetermined based on the presentation in the work plan (see Limnologic Data section, and Section 2.3 and in Section 3, Pit Lake and Groundwater Quality). The DQO process cited in the work plan is inadequate to address the pit lake. The "Guidance for the Data Quality Objectives Process" (EPA QA/G4, August 2000) must be used in this and other work plans to develop appropriate and relevant DQOs with supporting rationale. If this process is not used, or is modified without supporting rationale, then the work plan will remain inadequate.

22) Page 12, second paragraph: The question is way too broad to be adequately addressed. The question should be 1) What monitoring, sampling, and analytical activities for locations in and around the Yerington Pit Lake serve to evaluate the potential risk to the environment and/or to human health, 2) Support the development and evaluation of remedial actions at the Yerington Mine site. Due to plan deficiencies, neither of these questions are adequately addressed.

Because the alluvial aquifer discharges into the pit lake it plays a role in its water balance and geochemistry. Characterization of the alluvial aquifer needs to be added to the objective statements, particularly the first and second bullets on this page. Also see comments for pages 1 and 23.

23) Page 13, last paragraph: Why only one year of groundwater and pit water monitoring? Additional monitoring may be considered?

24) Page 14, Section 2.1: What general information from similar pit lakes in Nevada was used? What pit lakes in Nevada are similar to the Yerington Pit Lake?

25) Page 14, Section 2.1, first bullet: ARC should also consider computer modeling to determine hydrologic conditions (see comment 25).

26) Page 14, second paragraph: The level of investigations proposed within this work plan will not improve the level of understanding between the potential sources, media pathways and receptors relative to the pit lake.

27) Page 14, section 2.2, Hydrogeologic Conditions and Pit Lake Water Balance: The "Draft Groundwater Conditions Work Plan (Brown and Caldwell, 2002b)" has not been approved by (NDEP and the agencies) and at this point in its review cannot be used as a reference document.

28) Page 15, Section 2.2: The statement *"it is unlikely that hydraulic communication between the alluvial and bedrock aquifers is significant"* appears to ignore communication via the pit itself.

29) Page 15, Section 2.2, second paragraph: The conceptual model of the pit lake (see Figure 10) must also consider the potential for the pit lake to become a flow-through system.

30) Page 16, third paragraph: The statement, "*It is reasonable to assume that, like most other pit lakes developed in a strongly net evaporation setting, the Yerington Pit Lake will function as a groundwater sink characterized by a perpetual "cone-of-depression" in the bedrock aquifer (i.e., a terminal system).*" is not reasonable nor is it supported by the information provided in the work plan. For example, it is cited several times in the work plan that the Yerington Pit Lake is similar to other pit lakes in Nevada, yet no information to support this assumption is presented. Like all other mine sites that have pit lakes, the work plan must propose monitoring and sampling that will either support or invalidate this assumption. A suggestion is to gather and collect data for input into a groundwater software model such as MODFLOW to predict long-term steady-state conditions.

31) Page 16, second paragraph: The evaporation rate reported from Jewell (2002) on page 16 (1.2-1.5 m/yr) is the higher of two sets of results presented on page 4 (0.6-0.7 m/yr and 1.2-1.5 m/yr). What is the difference between the two data sets used to estimate the annual evaporation rate? Note that the evaporation rate exceeds the precipitation rate by 4 to 5 times or 9 to11 times (depending on which evaporation results are used), given an annual precipitation rate of 13.5 cm/yr, not 50 to 100 times as reported in the work plan.

32) Page 16, Section 2.2: Are the flows along the East side of the pit (identified as a spring) actually leakage from the Walker River via the channel that was cut and filled (page 16, Section 2.2)?

33) Page 17, second paragraph: An estimate of hydraulic gradient into the pit is not supported by the use of 1 groundwater monitoring well. And further, it cannot be estimated with much certainty with the addition of possibly 3 monitoring wells. More monitor wells must be proposed with the appropriate supporting rationale.

34) Page 17, last paragraph: The proposed field investigations will not provide data to develop a defensible water balance for the pit lake and the work plan needs to propose data collection to consider the recharge and discharge components of the pit lake.

35) Page 18, Section 2.3, first paragraph: The *Draft Groundwater Conditions Work Plan* (Brown and Caldwell, 2002b) has not been approved by NDEP and the agencies, and the current version of the plan remains severely inadequate to address current and future groundwater conditions. That plan has not demonstrated that the Yerington Pit Lake is not or will not directly affect groundwater quality in the shallow or even the bedrock aquifer.

36) Page 18, second paragraph: It is assumed that "steady-state" hydraulic conditions will control water quality characteristics of the pit lake, but the plan does not propose to demonstrate when this will occur (i.e., one year of sampling versus the proposed definition of "steady-state"). For example, what if the assumption that the pit lake will be a sink is incorrect and the pit lake turns out to be a flow-through system? This plan does not attempt to collect any long-term information that will support the assumptions made in this plan.

37) Page 18, last paragraph: Pit surface samples do not appear to indicate seasonal fluctuations (Appendix A) as suggested. And if the surface samples are a function of spring dilution and late summer evapo-concentrations, then where are the supporting calculations?

38) Page 18, paragraph 3: The work plan states that geochemical data presented in Table 3 show little variability in the chemical properties of bedrock ground water and that overall water quality is good. These statements would appear to be true (note error in Table 3, Well W2B, 3/9/1999: Co value should be TDS?), but water quality data are only given for two wells completed in the bedrock aquifer. Can such broad generalizations be reached by looking at only two wells? If more data are available, they should be presented in the work plan to strengthen this position.

39) Pages 18-20, 2.3 Geochemical Evolution of the Pit Lake: Figures in Appendix A are cited in this section. It would be helpful to individually number these figures for easier reference to the correct one. The last sentence of the second paragraph on page 18 is too simplistic; see the quotes from Jewell (2002) provided above. On page 18 in the last paragraph, before stating that the graphs for selenium and copper in Appendix A show decreasing values over time, one should statistically analyze the data. We recommend that data from surface water samples from the pit lake be excluded as they may be biased by collection location (see our comments above on collection locations during the Arimetco era). We have carefully examined the data for selenium at given depths where repeated samples were taken and see no evidence for the claim that selenium concentrations are decreasing. In fact the opposite appears to be true and is in agreement with the statement of Jewell (2002) cited above. However, copper concentrations, excluding data for surface water samples, appear to be declining. Time-concentration plots for TDS and sulfate do not clearly show the claimed seasonal evapoconcentration and dilution effects that are claimed at the bottom of page 18 and continuing to the top of page 19. Low or high concentrations do not appear to repeatedly occur in a given season of the year.

On page 19 in the first full paragraph, again we do not concur with the hypothesis that the chemical evolution of the pit water will remain similar to what has been monitored to date. Later in the same paragraph, we do not agree with the statement that "...constituent concentrations are likely to continue to decrease as the pit continues to refill." First, a careful examination of the selenium data appears to demonstrate the opposite. The statement is also in opposition to Atkinson (2002) who, when dealing with pit lakes in general, stated "Evaporation from the pit lake surface causes concentrations of dissolved constituents within the pit lake water to increase over time." He then provides the equation, that was incorrectly copied in the work plan (note V s should also be defined for the equation), and goes on to state "The evapoconcentration factor typically ranges from 10 to 40 times the concentration in the ground-water inflow. In the case of constituents such as arsenic, selenium, and many trace metals, evapoconcentration is a major consideration."

Miller (2002) provided limited data on the water quality of the Yerington pit lake that was collected in 1995 and cites another publication that also includes such data. We recommend that these data, although limited, be included in the draft work plan.

References are needed to support statements made in the last paragraph of page 19 and the first and second paragraphs on page 20.

We disagree with the last sentence on page 20. We believe it is premature to make such a statement. Many more years of monitoring may be needed to ultimately determine trends and future water quality conditions.

40) Page 19, second paragraph: The chemical evolution of the pit lake water is *"hypothesized to remain similar to what has been monitored to date."* ARC needs to propose work (data collection and analysis) to test this "hypothesis" otherwise an unacceptable level uncertainty will remain.

41) Page 19, paragraph 2: The work plan suggests that solute concentrations are likely to continue to decrease as the pit continues to refill. How much of a decrease is expected? Will concentrations evolve to vanishingly low levels? One might expect that a solubility limit will be reached, or a balance will be reached between adsorption/desorption kinetics. There is no mention in the work plan that these geochemical processes are being evaluated, outside of an empirical approach. For example, the equation that is presented (p. 19) describes concentration changes as a function of time, yet the equation only captures the concept of evaporative concentration changes – it ignores or lumps together all other chemical processes.

42) Page 19, paragraph 3: It is stated that evapo-concentration in the epilimnion will result in the precipitation of salts, hydroxides, and sulfates. These precipitates will only form if solubility is exceeded.

The work plan should be extended to examine these issues in more detail. It is further stated that these precipitates would sequester metals as they pass through the water column. It is also possible that as the precipitates pass through the epilimnion into deeper, more dilute levels of the water column, they will redissolve and release metals or they could redissolve during the spring dilution event. Information about the rate of particle settling also would be needed. It seems that the conceptual model is not based on a complete geochemical process understanding, but rather the conceptual model is selective.

43) Page 19, last paragraph: Is the wall rock that isn't submerged more or less reactive than the wall rock already submerged?

It would be good if the work plan could better explain what information is presented in the Jewell (2002) study. It is not clear what evidence exists that shows the presence in the water column of hydrous ferric hydroxides, precipitates that could potentially redissolve at low redox potentials and release metals.

44) Page 20, second paragraph: *"The hydrogeochemical conceptual model described above links the pit water balance to evaporative concentration as the dominant process that influences pit water quality."* The work plan does not attempt to validate this "conceptual model." The assumptions made (see page 19) need to be verified otherwise an unacceptable level of uncertainty will remain.

45) Page 20, last paragraph: It is evident in the work plan that the determination has already been made that the pit lake will be a terminal lake (see page 18, Section 2.3, first paragraph; page 20, third paragraph; and page 21, Section 3.1, second bullet). The proposed water balance analysis will not provide a basis to evaluate the question of whether the Yerington Pit Lake will be a terminal or flow-through system because the proposed work plan does not adequately evaluate groundwater characteristics around the lake nor does it propose that the appropriate information be collected.

46) Page 20, paragraph 3: The final paragraph in Section 2.3 suggests that water quality in the pit lake will remain the same or improve relative to current conditions. Under the proposed evapo-concentration hypothesis, mineral precipitation and metal adsorption would have to occur for the water quality to improve or remain unchanged.

The work plan suggests that the pit lake will be a terminal lake with ground-water inputs as the primary source of recharge and evaporation as the major discharge component. While this is a possibility, it may also be possible for the pit lake to exhibit flow-through conditions after the water level reaches a steady state. The work plan should be designed to examine all possible flow scenarios.

47) Page 21, Section 3.1, second bullet: See comment above. The appropriate information that will evaluate whether the pit lake will be a terminal or flow-through system must be collected.

48) Page 21, Section 3.1, third bullet: It must be determined whether the pit lake water quality will pose a risk to groundwater and human health and the environment now or in the future.

49) Page 21, Section 3.1, second paragraph: A one year monitoring period is proposed, but the plan does not provide a rational for this time frame. What is the rationale for one year of monitoring?

50) Page 21, Water Balance Components, first and second paragraphs: See comment above. What is meant by, "an appropriate basis"?

51) Page 21-23, 3.1 Proposed Field Investigations : In the first bullet on page 21, future steady state conditions should not be assumed at this time. The bullet should allow for estimates of the rate of possible changing conditions in the future. A word is missing in the second bullet after the word "will." In the third bullet, it is not sufficient to determine risks to human health or ecological receptors. Risks to both must be determined. In the second paragraph on page 21, we doubt that the results of field investigations and one year of subsequent monitoring activities will be adequate to ultimately determine trends in water quality in the pit lake; therefore, data collection

must be long-term, spanning multiple years. In the second full paragraph on page 22, we object to the use of the term "steady state" in the second line for the reasons given above. Steady state may be reached in a hydraulic context, but may not be reached in a chemical or biological context. On page 23, the sentence which begins on the third line is awkward ("...measurements will only be measured..."); please reword. On page 23, in the first full paragraph, please cite the model that will be used in the predictions.

52) Page 22, third paragraph: *"Precise locations of the new monitor wells will be established after on-site review of structural features exposed on the pit highwalls."*

The work plan needs to provide specific information on the type of structural features to be reviewed and clarify the efforts, which will be taken for this "review". In addition, based upon this review, the decision criteria for placement of a new well needs to be provided in the Plan. In order to fulfill DQOs, this work plan needs to elaborate on these criteria. This effort should be coordinated with companion work plans that address groundwater flow and contamination.

In addition to collecting groundwater elevation data, aquifer test data needs to be collected as well.

Figure 7 needs be used to site all proposed monitoring wells in this plan (see second sentence). The three proposed monitoring wells are not sufficient (see page 23, Pit Lake Groundwater Quality, first paragraph, second sentence). Additional wells should be proposed in the revised work plan.

53) Page 22, last paragraph: Only the quantity of surface water, e.g., alluvial groundwater, is being proposed. As previously commented, the geochemistry of the alluvial groundwater, e.g., surface water, needs to be monitored in the pit lake efforts.

54) Page 22 and page 23: Evaporation monitoring will be conducted using a Class A NWS evaporation pan (p. 22-23). Will an empirical pan coefficient need to be applied to the data to adjust for physical differences between the evaporation pan setting and the pit lake? Has a floating pan device, installed in the pit lake, been considered for evaporation data collection purposes?

55) Page 23, first paragraph, last sentence of <u>Pit Lake Groundwater Quality</u>: *"One or more existing wells may be substituted for a proposed well pending field investigations to determine the accessibility and suitability of the existing well for groundwater elevation measurements and water quality sampling."*

The criteria used in determining if a well is "suitable" needs to be presented in this work plan. Field investigations, unless borehole geophysical logging is being proposed, will not provide the most important information regarding the screened interval or down hole construction, and overall integrity of the well. In order to fulfill DQOs, this work plan needs to define these criteria.

56) Page 23, 3.1 Proposed Field Investigations, Pit Lake and Groundwater Quality : Due to our examination of past data indicating variability in concentrations in surface water samples we question the decision not to sample at depth. A more careful analysis of unbiased samples (note previous problems with sampling locations for surface water samples) should be conducted prior to making such a decision.

57) Page 23, second paragraph: Again, one year of data collection will not suffice. The plan lacks rationale to support the one year data collection proposal. Without collecting information from aquifer tests, which are not proposed, it will be impossible for the proposed plan to estimate with any real certainty when the pit lake will reach steady-state.

The use of an analytical model developed for pit lake refilling calculations must be submitted for review and approval by the agencies. Why wasn't the model named? Where in California and Nevada has it been used? Were the data inputs, calibration and verification results accepted by the appropriate agencies?

58) Page 23, Pit Lake and Groundwater Quality: The number of existing (one) and proposed monitor wells (maybe three) is insufficient as is the proposed monitoring schedule of one year. ARC's determination of existing wells' suitability needs be included in this work plan.

Jewel (see Appendix A) concluded that copper, sulfate and selenium will impact groundwater once the lake becomes a flow through system. This plan ignores this information and proposes nothing to investigate and monitor these potential impacts. Obviously, the plan must propose something of material value to resolve this issue.

Jewel states (predicts), with some certainty, that anoxic conditions will probably not be a factor in the overall environmental impact of the mine or the surrounding area. This plan does not propose monitoring to verify whether Jewel's prediction is correct or not. Again, the plan must propose something of material value to resolve this issue as well.

59) Page 23: Because the work plan emphasizes the potential importance of ground-water flow along fractures in the bedrock aquifer, what method(s) will be used to estimate subsurface discharge from the bedrock aquifer to the pit?

60) Page 23, Section 3.1: Why is no water quality sampling at depth proposed? Will lack of this data impair the assumption that pit water mixes due to turn over events in the pit (page 23, Section 3.1)?

61) There is no strong geochemical effort proposed in the work plan other than to scan water quality indicators. Section 3 of the work plan indicates that ground-water and pit water samples will be collected and analyzed for major ions, trace metals, and field parameters, but the work plan does not discuss how these data will be used to draw or support conclusions from this study. The work plan notes that observed temporal concentration decreases and seasonal fluctuations provide important empirical data upon which a conceptual model can be developed. The data should be taken further in terms of evaluating geochemical processes that are important in the pit lake and the bedrock aquifer.

62) Page 24, last sentence: *"A 20-ft screen interval will be installed in the upper 40-ft of saturated bedrock with filter pack…"*

The leniency of "20-ft screen in the upper 40-ft of aquifer" is inconsistent with industry practice. The goal for this proposed practice should be presented and discussed in this Plan. If wells near the pit are all completed at differing intervals, the data will be difficult to compare and conclusions may be in error. Because the water table near the pit lake will continue to rise, it makes sense to straddle the top of water with the majority of a well screen above the water, not somewhere within the upper 40ft.

63) Page 26, last sentence: *"Existing large diameter wells will be purged until field parameters stabilize…"*

The Plan needs to define the diameter in which this will take place.

64) Page 27, Section 3.2: It is acceptable to dispose of well purge water in the Pit Lake as proposed (page 27, Section 3.2).

The work plan does not discuss collecting and analyzing water quality samples from the seeps and springs which discharge to the pit. Depending on the magnitude of these inflows, these data may be necessary to calculate the mass balance based on water chemistry. This information may already be available from the Ron Hershey study of the pit lake and if so, should be included in the work plan.

65) Page 28, Section 3.2: Pit Lake samples are proposed at only one location, at the end of the ramp. It would seem better to collect from several locations away from the high wall, and then form a composite sample.

The work plan proposes collecting hydrologic data (precipitation, evaporation, pit lake and ground water levels, seep/spring gaging, etc.) for a period of one year. Will these short-term physical data be appropriate for estimating a long-term water balance? Additionally, the work plan proposes collecting water quality samples in the early spring and late summer of the coming year in order to provide a baseline for seasonal fluctuations in ground-water and pit lake water quality. Will this provide enough data to characterize seep/spring, ground water, and pit lake water quality and to provide an adequate baseline for seasonal fluctuations? A longer term sampling and monitoring program would more likely achieve meaningful results.

66) Page 28-29, 3.2 Quality Assurance/Quality Control Procedures, Pit Water Sampling and Field Parameters: In the first paragraph of page 28, we recommend that surface water samples be consistently collected near the center of the lake, not in the shallow area of the ramp where concentrations in samples may be affected by sediment conditions in the shallows which could change as the lake fills. Sampling at this point might also be affected by disturbance of the sediment while wading into the water during sample collection. In the first paragraph of page 29, it is not clear what flow rates will be calculated and for what purpose. The last sentence of the second paragraph, for the most part, does not appear to be applicable to sample collections in the pit lake.

67) Page 30-31, 3.2 Quality Assurance/Quality Control Procedures, Sample Identification and Preservation H_2SO_4 should be defined in a footnote to the table on page 30. The sentence at the top of page 31 needs to be expanded to include collection of pit lake water samples. The draft plan does not include future sampling of water quality in seeps and springs flowing into the pit lake. The rationale for this decision should be provided.

68) Figure 3: Please clarify the legend for Figure 3. What is AHA? The symbols for accessible AHA monitored and destroyed look the same.

69) Figure 11: Proposed monitoring location symbols (Figure 11) for existing wells and proposed wells look the same. It is suggested that new wells be installed at both the Northwest and Southeast ends of the Pit Lake. The Northwest to better define flow between the site and the Pit Lake and the Southeast to define flow between the Walker River and the Pit Lake.

70) Tables: Please indicate the meaning of "- - " in Tables 3 to 5; we assume that the samples were not analyzed for these constituents. The units of concentration should be added to Table 3. In Table 3, it appears that the value for cobalt for the March 9, 1999 sample should be shifted to the line for total dissolved solids. We also noted very large shifts in concentrations of copper and iron in well WW-36 between February 1, 1993, and June 1, 1994. Are these data reported correctly? In Table 4, footnotes 2, 3, 4, and 6 appear at the end of the table, but do not appear in the table itself. In Table 5, the concentration for cadmium for October 13, 1992, appears to be in error. In Table 5, footnote 6 was not found in the table, only at the end. If the source documents for Table 5 provide information on the sampling locations, the information should also be provided in the table as this information may be important for proper interpretation of the data. Table 5 also does not provide complete information on whether the concentrations are for total or dissolved constituents; this should be remedied. Mercury concentrations for August 16, 1998, are listed as and appear to be in error. Table 6,The COC Table must be revised to incorporate analytes that have been detected in prior monitoring, such as radionuclides.

71) Appendices: The third figure in Appendix A provides data on sulfate concentrations. The zero value on the figure was not found in Table 5 for the date of sampling that was given on the figure. In Appendix B, a portion of the print on the left side of the page was cut off in photocopying the report.

Accordingly, please provide the **Draft Final Yerington Pit Lake Work Plan** which adequately incorporates the above comments. This information must be received not later September 8, 2003, as per the approved submittal schedule.

Should you have any questions or if I can be of any assistance, please do not hesitate to contact me at (775) 687-9376 or FAX (775) 687-6396. All future correspondence regarding this subject should be addressed to the undersigned.

Sincerely,

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